Sunter

OUT

12-10-90

Cathy

Find attached suggested, temporary revisions to Draft Risk Assessment. Our approach is to provide a general introduction and outline for the RA. However any calculations, conclusions, and recommendations have been deleted. I donot want to present any items at this time that may be critical to the RA and give the appearance that they can be negotiated.

Your Re-Draft should be stamped DRAFT and provided under cover letter to me, by December 17, if at all possible. The cover letter will introduce your prop. of a preliminary draft RA. It should also recognize that the RA cannot be completed until our RI report is prepared which presents all of the info to be considered in the RA. Any questions call Mark Bogina or me

913 551-7528 -7726

Thanks
Glenn Curtis

SYNTEX AGRIBUSINESS, INC. DRAFT

GROUND WATER RISK ASSESSMENT

This document provides an introduction and brief outline for the site groundwater operable unit risk assessment. The site risk assessment will be completed subsequent to preparation of the Remedial Investigation (RI) Report

BACKGROUND

The Syntex Agribusiness, Inc. facility is located near the town of Verona (population approx. 500) in southwestern Missouri. The site is approximately 30 miles southwest of Springfield Missouri.

The Syntex facility in Verona first became the focus of environmental concerns about 1960. At that time the facility was owned and operated by Hoffman-Taff, Inc. From approximately that time until 1969, the facility produced 2,4,5-trichlorophenoxy acetic acid herbicide (2,4,5-T). In 1969, Syntex Agribusiness acquired the facility and manufactured hexachlorophene from 1970 to 1971. Both 2,4,5-T and hexachlorophene manufacture resulted in the by-product formation of dioxins, in particular, high concentrations of 2,3,7,8-tetrachlorodibenzo-p-dioxin. Concerns over dioxin contamination triggered a series of investigations at the Verona facility. Remediation of dioxin contaminated soils has been addressed in the Record of Decision signed May 5, 1988.

The Agency for Toxic Substances and Disease Registry (ATSDR) performed several toxicology consultations at the request of the U.S. EPA. These consultations (ATSDR 1989 as ammended 1990) specifically addressed the public health implications of consuming dioxin contaminated fish from the Spring River. Groundwater consumption was not addressed in these consultations.

Groundwater contamination is being treated as a separate operable unit for the purposes of remediation. This risk assessment document deals exclusively with chemicals of concern in groundwater associated with the Syntex Agribusiness, Inc. Verona facility. No dioxins or furans were detected in groundwater at the required quantitation limits.

PHYSICAL SETTING

The major portion of the 180 acre Syntex facility is located within the 100 year flood plain of the Spring River. The facility is west of Verona and on the east bank of the Spring River. The Spring River originates south of Verona and flows northward along the western outskirts of town.

HYDROGEOLOGIC ASSESSMENT

The Syntex facility is situated in the flood plain of the Spring River Basin. The Spring River flows north in the vicinity of the facility through an alluvial valley that is underlain by limestone bedrock. The alluvial sediments consist of several feet of silty loam underlain by gravel between 10 feet and 30 feet thick. Underlying the alluvium is limestone with documented karst features. Flooding in the valley is common.

Dioxins have not been reported in the ground water in the vicinity of the Syntex facility. Aquifers that might be impacted by previous site activities include the upper alluvial aquifer and the lower limestone aquifer. Potential receptors for ground water contamination are identified in the event that contaminants from the Syntex facility have entered the ground water system.

Suspected pathways for contaminant migration in ground water to potential receptors include infiltration of contaminants from the facility downward to the ground water table during precipitation events and then transportation hydraulically downgradient in either of the aquifer systems. Alternatively, recurring flooding of the Spring River may have led to the sweeping away of contaminated sediments at the facility and redeposition of these sediments down-valley. Infiltration from precipitation could potentially transport contaminants downward to the ground water table.

In the event that contaminants from the site have entered ground water beneath the Syntex facility, potential receptors would include private well owners hydraulically downgradient of the facility or well users in which pumping of their wells could modify the local flow direction of ground water and

potentially draw in contaminants. Wells subject to potential contamination could / would be screened either in the valley alluvium or limestone bedrock underlying the alluvium and adjacent to the valley.

A record search of well logs obtained from the Missouri Department of Natural Resources, Division of Geology and Land Survey (DGLS) indicate no well logs on-file for private wells within two miles of the facility that are set within alluvial sediments or limestone bedrock of the flood plain. Well logs are available for private wells within two miles of the Syntex facility but most of these wells are either well outside the flood plain beyond the influence of potential contamination or hydraulically upgradient (Figure 1). Two wells are located outside of the flood plain, one approximately 1,000 feet northwest of the trench area, and the second approximately 2,500 feet north-northeast of the trench area. These well locations may be indicative of potential receptors.

According to the U.S.G.S. 7.5 Minute map of the Verona Quadrangle, at least nineteen houses are located down-valley of the facility and within or adjacent to the flood plain. Well logs are not on-file with the DGLS for these houses, but this does not exclude the possibility of wells being present. If these houses have private wells, they may be identified as potential receptors.

The Syntex Agribusiness facility in Verona is considered an industrial site. Deed restrictions are in place at the site maintaining this status imperpituity. (SA?)

POTENTIALLY EXPOSED POPULATIONS

Future potentially exposed populations include existing or future downgradient residential wells and the development of future residences on the Syntex property which would include placement of onsite wells. The focus of this risk assessment is on any future residential development of the site at and downgradient

However future development on the Syntex property is highly unlikely.

IDENTIFICATION OF EXPOSURE PATHWAYS

Domestic use of unremediated groundwater is the only exposure pathway which will be considered in this risk assessment.

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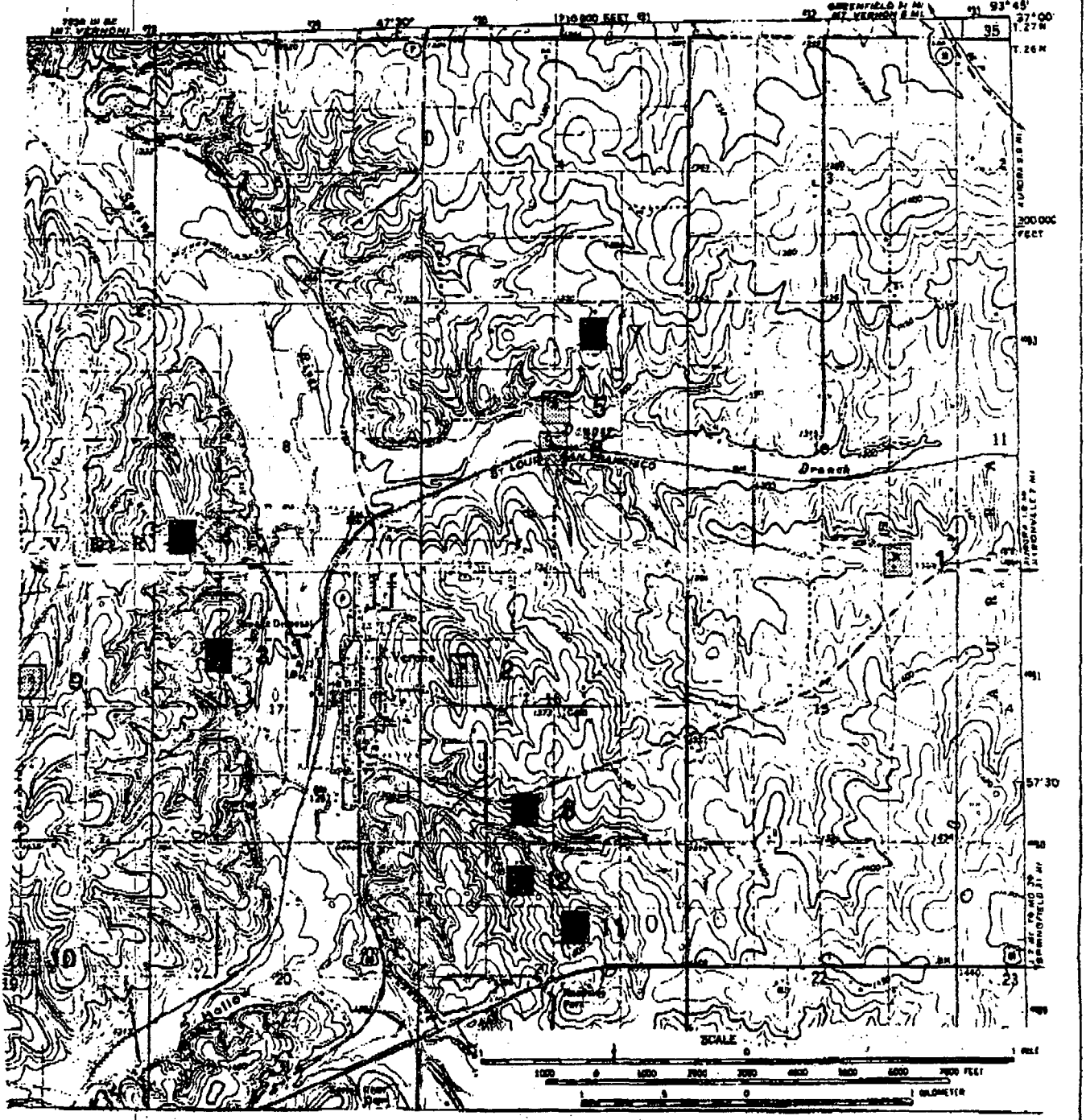

■ Actual Locations

⊡ Approximate Locations

Metcalf & Eddy	LOCATION OF PRIVATE WELLS IN THE VICINITY OF THE SYNTEX FACILITY SOURCE: U.S.G.S. VERONA QUADRANGLE	Project Number 270026
		FIGURE 1

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delete this sentence for now

The potential contaminants of concern are listed in Table 1 along with a summary of analytic results for quarterly ground water sampling performed during 1989 and 1990. Although other ground water sampling was performed in 1987, these data were not examined in the present risk assessment. The contaminants of concern presented in table 1 were selected for further study based on a validation of the ground water sampling results, comparison of sampling results to background concentrations, and whether the compounds of interest are considered to be essential nutrients or toxic. Additional information can be considered subsequent to compilation and discussion of all available data in the RI Report.

EXPOSURE PATHWAYS AND EXPOSURE ROUTES

Exposure pathways describe the movement of chemicals from sources to locations (exposure points) where groups of people (receptors) may come in contact with the chemicals. This movement involves release of chemicals from the source to an intermediate environmental transport medium (groundwater in this case) and the receptor point. Exposure routes describe the modes of contact with and intake of contaminated media and chemicals at exposure points.

For this risk assessment, unremediated groundwater is the exposure pathway under consideration. Three potential routes of exposure will be evaluated on a chemical specific basis; 4 ? can

* ingestion of chemicals in groundwater
* dermal absorption while showering
* inhalation of vapor phase volatiles while showering
* Irrigation - - - - - -

QUANTIFICATION OF EXPOSURE

Estimates of exposure levels for each contaminant are required for quantitative risk characterization. The basic equation to calculate human intake of an environmental contaminant is:

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TENTATIVE

potential

TABLE 1 SUMMARY OF GROUND WATER RESULTS FOR CONSTITUENTS OF CONCERN AT THE SYNTEX FACILITY (mg/L) *

Verona

COMPOUND	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	UPPER LIMIT 95% C.I.
Ba	0.047	10.5	1.6822	2.2068	6.0958
Be	0.0029	0.06	0.0116	0.0149	0.0413
Cd	0.0024	0.061	0.0133	0.0196	0.0524
Cr	0.005	30.2	1.4682	5.7819	13.0356
Pb	0.001	230	7.9943	41.9554	91.9050
Ni	0.04	1.9	0.1053	0.3624	0.8302
Zn	0.055	34	1.9785	7.1199	16.2182
Benzene	0.001	0.25	0.0256	0.0617	0.1491
Trichloroethene	0.005	0.25	0.0260	0.0616	0.1492
Toluene	0.005	0.25	0.0310	0.0663	0.1638
Chlorobenzene	0.002	0.25	0.0416	0.0670	0.1757
Ethyl Benzene	0.005	0.25	0.0272	0.0614	0.1500
Xylenes, total	0.001	0.25	0.0361	0.0658	0.1676
1,4-Dichlorobenzene	0.01	0.11	0.0228	0.0293	0.0814
Methoxychlor	0.0005	0.0031	0.0013	0.0009	0.0031

* The final list of constituents of concern will be compiled and considered subsequent to completion of the RI Report.

DI = C x HIF

where:

DI = Daily intake (mg of chemical per kg of body weight per day)
C = Concentration of the chemical
HIF = Human intake factor (units of medium per kg of body weight per day)

Intake variables ~~have been~~ will be selected so that the combination of all intake variables results in an estimate of a reasonable maximum exposure (RME) for the groundwater pathway. The RME is defined by US EPA (1989a) as the maximum exposure that is reasonably expected to occur at or near a given site.

METHODS FOR ESTIMATING INTAKE LEVELS

same ¶

It is assumed that there could be future residences on the property now occupied by the Syntex Agribusiness facility. Contaminants in soil have already been addressed in the Record of Decision For Final Management of Dioxin Contaminated Soil and Equipment at Syntex Agribusiness, Inc., Verona Missouri, April 29, 1988. ~~This~~ The site and downgrad. of risk assessment will address potential future exposures to groundwater contaminants at the Syntex Agribusiness site. In ~~this~~ The exposure scenario, it is assumed that persons will reside on the site and use unremediated groundwater for all domestic purposes including drinking and cooking.

will be

4 Three specific routes of exposure to contaminants in ground water ~~are~~ may be addressed: ingestion, dermal absorption while showering, and inhalation of volatile components while showering. By convention, daily intakes of the contaminants of concern will be estimated for an average ~~70 kg~~ adult and for a 16 kg child (1 to 6 years old). It is assumed that the adult will reside on the Syntex site for a maximum of 30 years (national 90th percentile time at one residence as estimated by U.S. EPA). During this 30 years, it is assumed that exposure to contaminants in groundwater occurs 365 days per year. Children are assumed to be exposed for five years. Subchronic intake for

Irrigation

adults and children will be based on five years of exposure. Chronic intakes will be calculated only for adults based on 30 years of residence on the site. Carcinogenic effects will be estimated for 30 year exposure duration for adults and 5 years for children, both averaged over a 70 year lifetime.

INGESTION OF GROUNDWATER

Daily intake of contaminants of concern through ingestion of groundwater will be estimated for both an average adult and child. A 70 kg adult is assumed to drink 2 liters of water or beverages made with groundwater every day, 365 days per year for either 5 years (subchronic effects) or 30 years (chronic noncarcinogenic and/or carcinogenic effects). A 16 kg child is assumed to drink 1 liter of water or beverages every day for 365 days per year for 5 years. It is further assumed that the administered dose, as estimated by the daily intake, is also the absorbed dose.

DERMAL ABSORPTION WHILE SHOWERING

It is assumed that any future residents on the Syntex Agribusiness site will shower every day for 365 days per year using unremediated ground water. Dermal absorption of semi-volatile or inorganic compounds may occur during showering. A 70 kg adult is assumed to have a skin surface area of 18,150 cm^2. A 16 kg child is assumed to have a corresponding skin surface area of 9,400 cm^2. Shower exposures are assumed to last a maximum of 15 minutes. Where available, chemical specific permeability constants will be used to estimate the amount of the chemical absorbed through the skin and into the peripheral circulation. Where chemical specific permeability constants are not available, standard values for soluble and insoluble compounds will be utilized.

As described for the ingestion route of exposure, showering will be assumed to occur 365 days/year for 30 years for adults and 365 days/year for 5 years for children. Subchronic, chronic noncarcinogenic, and carcinogenic effects will be estimated as described previously.

INHALATION OF VAPOR PHASE CHEMICALS WHILE SHOWERING

Under shower conditions in a confined area, volatile organic chemicals present in groundwater would be expected to enter vapor phase. Consequently, inhalation of volatile organic compounds while showering could contribute to an individual's total exposure. The amount of each volatile compound vaporizing into the air during a 15 minute shower will be estimated based on the concentration in ground water. The enclosed volume of a 1 m x 1 m x 2.5 m shower stall is assumed to be 2.5 m^3. Determination of chemical concentrations of waterborne VOCs in shower stall air were determined by using a flow rate of 15 gallons/minute (56.8 l/minute), multiplied by a shower duration of 12 minutes (U.S. EPA, 1989a), divided by shower stall dimensions of 2.5 m^3. The resulting quantity of water per unit volume from which VOCs could volatilize is 273 l/m^3.

While showering, the individual is assumed to inhale the estimated mean concentration of the chemical for 0.25 hours each day for 365 days per year. Respiration rate is assumed to be 0.6 m^3/hour for both adults and children (U.S. EPA 1989). All other assumptions are as described previously.

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TABLE 6 —

Ingestion of Groundwater

Equation (U.S.EPA, 1989a):

$$\text{Intake (mg/kg day)} = \frac{CW \times IR \times EF \times ED}{BW \times AT}$$

VARIABLE	VARIABLE DESCRIPTION	GROUNDWATER ASSUMPTIONS
CW	Chemical Concentration in Water (mg/liter)	Constituent Concentration in Groundwater
IR	Ingestion Rate (liters/day)	2 liters/day (adult) 1 liter/day (child)
EF	Exposure Frequency (days/year)	365 days/year
ED	Exposure Duration (years)	30 years for adults (chronic and carcinogenic effects) 5 years for adults (subchronic effects) 5 years for child (subchronic and carcinogenic effects)
BW	Body Weight (kg)	70 kg (adult) 16 kg (child)
AT	Averaging Time (period over which exposure is averaged - days)	25,550 days (carcinogenic effects) 10,950 days (chronic noncarcinogenic effects) 1,825 days (subchronic effects)

TABLE 3 —

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Dermal Contact with Groundwater

Equation (U.S.EPA, 1989a):

$$\text{Intake (mg/kg day)} = \frac{CW \times SA \times PC \times ET \times EF \times ED \times CF}{BW \times AT}$$

VARIABLE	VARIABLE DESCRIPTION	GROUNDWATER ASSUMPTIONS
CW	Chemical Concentration in Water (mg/liter)	Constituent Concentration in Groundwater
SA	Skin Surface Area Available for Contact (cm)	18,500 cm^2 (adult) 9,400 cm^2 (child)
PC	Chemical Specific Dermal Permeability Constant (cm/hr)	Chemical Specific (cm/hr)
ET	Exposure Time	0.25 hours/day
EF	Exposure Frequency (days/year)	365 days/year
ED	Exposure Duration (years)	30 years for adults (chronic and carcinogenic effects) 5 years for adults (subchronic effects) 5 years for child (subchronic and carcinogenic effects)
CF	Volumetric Conversion Factor for Water (1 liter/1000 cm)	1 liter/1000 cm^3
BW	Body Weight (kg)	70 kg (adult) 16 kg (child)
AT	Averaging Time (period over which exposure is averaged - days)	25,550 days (carcinogenic effects) 10,950 days (chronic noncarcinogenic effects) 1,825 days (subchronic effects)

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TABLE —

Inhalation of Vapor Phase Chemicals While Showering with Groundwater

Equation (U.S.EPA, 1989a):

$$\text{Intake (mg/kg day)} = \frac{CA \times IR \times WV \times ET \times EF \times ED \times CF}{BW \times AT}$$

VARIABLE	VARIABLE DESCRIPTION	GROUNDWATER ASSUMPTIONS
CA	Chemical Concentration in Air During Shower (mg/m^3)	Constituent Concentration in Air During Shower
WV	Water Quantity per unit volume (L/m^3)	273
IR	Inhalation Rate (m^3/hr)	$0.6 m^3/hr$
ET	Exposure Time (hours/day)	0.25 hours/day
EF	Exposure Frequency (days/year)	365 days/year
ED	Exposure Duration (years)	30 years for adults (chronic and carcinogenic effects) 5 years for adults (subchronic effects) 5 years for child (subchronic and carcinogenic effects)
BW	Body Weight (kg)	70 kg (adult) 16 kg (child)
AT	Averaging Time (period over which exposure is averaged - days)	25,550 days (carcinogenic effects) 10,950 days (chronic noncarcinogenic effects) 1,825 days (subchronic effects)

TABLE 5 ESTIMATED HAZARD/RISK RESULTING FROM INGESTION OF GROUND WATER

COMPOUND	ADULT SUBCHRON NONCARC HAZARD	ADULT CHRONIC NONCARC HAZARD	ADULT CHRONIC CARCIN RISK	CHILD SUBCHRON NONCARC HAZARD	CHILD CHRONIC CARCIN RISK
Ba	0.9612	0.6866		2.1027	
Be	0.0656	0.0656	6.05E-04	0.1436	2.21E-04
Cd		0.7576			
Cr	2.0974	8.3896		4.5881	
Pb					
Ni	0.1505	0.1505		0.3291	
Zn	0.2826	0.2826		0.6183	
Benzene			9.10E-06		3.32E-06
Trichloroethene			3.50E-06		1.28E-06
Toluene	0.0022	0.0044		0.0048	
Chlorobenzene	0.0059	0.0595		0.0130	
Ethyl Benzene	0.0008	0.0078		0.0017	
Xylenes, total	0.0003	0.0005		0.0006	
1,4-Dichlorobenzene	0.0007		6.71E-06	0.0016	2.44E-06
Methoxychlor	0.0004	0.0074		0.0008	
TOTAL	3.57	10.41	6.24E-04	7.80	2.28E-04

TABLE 6 ESTIMATED HAZARD/RISK RESULTING FROM DERMAL CONTACT WITH GROUND WATER WHILE SHOWERING

COMPOUND	ADULT SUBCHRON NONCARC HAZARD	ADULT CHRONIC NONCARC HAZARD	ADULT CHRONIC CARCIN RISK	CHILD SUBCHRON NONCARC HAZARD	CHILD CHRONIC CARCIN RISK
Ba	0.0333	0.0238		0.0741	
Be	0.0023	0.0023	2.18E-06	0.0051	7.77E-08
Cd		0.0375			
Cr	0.0146	0.0582		0.0323	
Pb					
Ni	0.0052	0.0052		0.0116	
Zn	0.0033	0.0033		0.0073	
Benzene			2.34E-06		8.66E-07
Trichloroethene			8.10E-07		3.00E-07
Toluene	0.0005	0.0010		0.0011	
Chlorobenzene	0.0046	0.0458		0.0102	
Ethyl Benzene	0.0002	0.0022		0.0005	
Xylenes, total	0.0001	0.0001		0.0001	
1,4-Dichlorobenzene	0.0002		1.55E-06	0.0004	5.75E-07
Methoxychlor	0.0001	0.0017		0.0002	
TOTAL	0.06	0.18	2.57E-05	0.14	9.51E-06

TABLE 7 ESTIMATED HAZARD/RISK RESULTING FROM INHALATION OF GROUND WATER WHILE SHOWERING

COMPOUND	ADULT SUBCHRON NONCARC HAZARD	ADULT CHRONIC NONCARC HAZARD	ADULT CHRONIC CARCIN RISK	CHILD SUBCHRON NONCARC HAZARD	CHILD CHRONIC CARCIN RISK
Benzene			1.86E-04		1.36E-04
Trichloroethene			1.11E-04		8.08E-05
Toluene	0.0318478619	0.03184786		0.1393343956	
Chlorobenzene	4.870125	4.870125		21.306796875	
Ethyl Benzene					
Xylenes, total	0.2463809072	0.07038281		1.0779164692	
Methoxychlor				0.0082859766	
TOTAL	5.15	4.97	2.97E-04	22.53	2.17E-04

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EXPOSURE CONCENTRATIONS

~~In keeping with the conservative nature of this risk assessment,~~ exposure point concentrations in groundwater ~~were~~ based on the maximum detected concentration of each chemical. Estimations of exposure concentrations assume that levels of each chemical will remain constant over the duration of the exposure period. This ~~is an extremely~~ conservative assumption, given that groundwater flows would be expected to cause the concentrations of most source related contaminants to decrease over time.

TOXICITY OF CHEMICALS OF POTENTIAL CONCERN

The most critical effects of the chemicals of concern are summarized in the following tables. Brief toxicological profiles can be found in Appendix B.

RISK CHARACTERIZATION

Evaluation of Noncarcinogenic Risks:

The risk of adverse noncarcinogenic effects from chemical exposure is expressed in terms of the Hazard Index (HI). The HI is the ratio of the estimated dose which a hypothetical receptor would receive to the estimated dose level believed to be without measureable adverse effects. The estimated "safe" dose level is termed the Reference Dose (RfD). The Hazard Index is calculated as follows:

$$HI = CDI/RfD$$

Where:

HI = Hazard Index for Chronic Exposure
CDI = Chronic Daily Intake
RfD = Reference Dose

If the Hazard Index is less than 1.0, it is believed that the risk of noncarcinogenic effects is very low. If the HI exceeds 1.0, there is a risk of adverse noncarcinogenic effects. However, this risk is still likely to be

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TABLE 8

SYNTEX AGRIBUSINESS FACILITY, VERONA, MISSOURI

TOXIC EFFECTS ASSOCIATED WITH CHEMICALS OF CONCERN

	NONCARCINOGENIC EFFECTS		CARCINOGENIC EFFECTS*	
CHEMICAL	ORAL	INHALATION	ORAL	INHALATION
Barium	Incr. Blood Pressure	Fetotoxicity	Inconclusive (Group D)	Inconclusive (Group D)
Beryllium	ND	None Observed	Total Tumors (Group B2)	Lung Tumors (Group B2)
Cadmium	Renal Toxicity	Cancer	NA	Respiratory Tumors (Group B2)
Chromium III	Hepatotoxicity	NA	Inconclusive (Group D)	Inconclusive (Group D)
Chromium VI	ND	Cancer	NA	Lung Tumors (Group A)
Lead	Central Nervous Toxicity	Central Nervous Toxicity	NA (Group B2)	NA (Group B2)
Nickel	Decr. Body Weight	Cancer	NA	Respiratory Tumors (Group A)
Zinc	Anemia	NA	Inconclusive (Group D)	Inconclusive (Group D)
Ethylbenzene	Hepatotoxicity and Nephrotoxicity	NA	Inconclusive (Group D)	Inconclusive (Group D)
Toluene	Central Nervous System Toxicity	Central Nervous System Toxicity Eye and Nose	Inconclusive (Group D)	Inconclusive (Group D)
Xylenes	Hyperactivity Weight Loss	Central Nervous System Toxicity; Nose and Throat	Inconclusive (Group D)	Inconclusive (Group D)
Chlorobenzene	Hepatotoxicity and Nephrotoxicity	Hepatotoxicity and Nephrotoxicity	Inconclusive (Group D)	Inconclusive (Group D)
Trichloroethane	NA	NA	Liver Tumors (Group B2)	Lung Tumors (Group B2)
1,4–Dichlorobenzene	NA	Hepatotoxicity and Nephrotoxicity	Liver Tumors (Group B2)	NA
Methoxychlor	Fetotoxicity	NA	Inconclusive (Group D)	Inconclusive (Group D)

*U.S. EPA Weight of Evidence Classification:

11 A

TABLE 8 (CONTINUED)

Group A, Human Carcinogen
Group B, Probable Human Carcinogen
Group C, Possible Human Carcinogen
Group D, Not Classifiable
Group E, Evidence of Noncarcinogenicity

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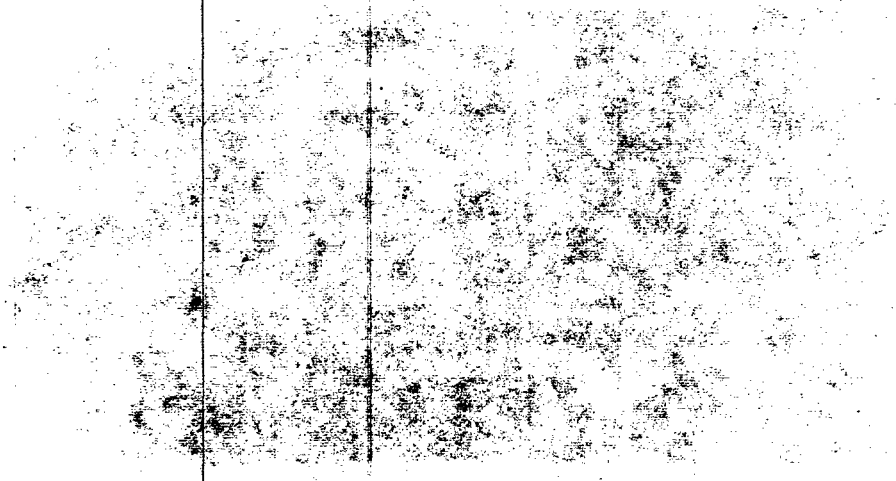

11 B

small since RfDs are developed in a highly conservative manner. The available oral Reference Doses for chemicals of concern are listed in Table? IN Appendix B Tables 9, 10 and 11 present the hazards associated with the chemicals of potential concern.

Evaluation of Carcinogenic Risks:

Chemicals for which there is human and/or laboratory evidence of carcinogenicity will be assessed for potential lifetime cancer risk. The risk of cancer from exposure to a specific chemical under specified exposure circumstances is expressed as a probability value. This is termed the excess lifetime risk because it is in addition to an individual's already existant chances of developing cancer during his or her lifetime. The excess lifetime risk for a given chemical is calculated by multiplying the Chronic Daily Intake by the Cancer Potency Factor, also termed the Slope Factor as derived from laboratory data.

$$\text{Cancer Risk} = \text{CDI} \times \text{SF}$$

Risk estimates are presented as excess cancer risk per unit of exposed population. This risk assessment will use the Slope Factors which have been derived by U.S. EPA. These calculations are extremely conservative and provide a 95% upper bound estimate of the risk. This means that the true risk may be lower than the calculated probability, but is not likely to be higher.

Because an individual may be exposed to many different potentially carcinogenic chemicals at the same time, the risk estimates are added together for all chemicals in a specific pathway and for all pathways. In this case, risk estimates will be added for all routes of exposure encompassed by the groundwater pathway. Tables 9, 10 and 11 present the summation of the individual carcinogenic risks for each potentially carcinogenic chemical of concern.

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UNCERTAINTIES IN RISK ASSESSMENT

Several potential assumptions and accompanying uncertainties associated with estimating the risks from consumption of unremediated groundwater at the Syntex Verona facility are summarized below.

12A

TABLE 9. ESTIMATED HAZARD/RISK RESULTING FROM INGESTION OF GROUND WATER

COMPOUND	ADULT SUBCHRON NONCARC HAZARD	ADULT CHRONIC NONCARC HAZARD	ADULT CHRONIC CARCIN RISK	CHILD SUBCHRON NONCARC HAZARD	CHILD CHRONIC CARCIN RISK
Ba	0.9612	0.6866		2.1027	
Be	0.0656	0.0656	6.05E-04	0.1436	2.21E-04
Cd		0.7576			
Cr	2.0974	8.3896		4.5881	
Pb					
Ni	0.1505	0.1505		0.8291	
Zn	0.2828	0.2828		0.6183	
Benzene			9.10E-06		3.32E-06
Trichloroethene			3.50E-06		1.28E-06
Toluene	0.0022	0.0044		0.0048	
Chlorobenzene	0.0059	0.0595		0.0130	
Ethyl Benzene	0.0008	0.0078		0.0017	
Xylenes, total	0.0003	0.0005		0.0006	
1,4-Dichlorobenzene	0.0007		6.71E-06	0.0016	2.44E-06
Methoxychlor	0.0004	0.0074		0.0008	
TOTAL	3.57	10.41	6.24E-04	7.80	2.28E-04

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TABLE 10 ESTIMATED HAZARD/RISK RESULTING FROM DERMAL CONTACT WITH GROUND WATER WHILE SHOWERING

COMPOUND	ADULT SUBCHRON NONCARC HAZARD	ADULT CHRONIC NONCARC HAZARD	ADULT CHRONIC CARCIN RISK	CHILD SUBCHRON NONCARC HAZARD	CHILD CHRONIC CARCIN RISK
Ba	0.0333	0.0238		0.0741	
Be	0.0023	0.0023	2.10E-05	0.0051	7.77E-06
Cd		0.0375			
Cr	0.0146	0.0582		0.0323	
Pb					
Ni	0.0052	0.0052		0.0116	
Zn	0.0033	0.0033		0.0073	
Benzene			2.34E-06		8.66E-07
Trichloroethene			8.10E-07		3.00E-07
Toluene	0.0005	0.0010		0.0011	
Chlorobenzene	0.0046	0.0458		0.0102	
Ethyl Benzene	0.0002	0.0022		0.0005	
Xylenes, total	0.0001	0.0001		0.0001	
1,4-Dichlorobenzene	0.0002		1.55E-06	0.0004	5.75E-07
Methoxychlor	0.0001	0.0017		0.0002	
TOTAL	0.06	0.18	2.57E-05	0.14	9.51E-06

TABLE II ESTIMATED HAZARD/RISK RESULTING FROM INHALATION OF GROUND WATER WHILE SHOWERING

COMPOUND	ADULT SUBCHRON NONCARC HAZARD	ADULT CHRONIC NONCARC HAZARD	ADULT CHRONIC CARCIN RISK	CHILD SUBCHRON NONCARC HAZARD	CHILD CHRONIC CARCIN RISK
Benzene			1.86E-04		1.36E-04
Trichloroethene			1.11E-04		8.08E-05
Toluene	0.0318478618	0.03184786		0.1393343956	
Chlorobenzene	4.870125	4.870125		21.306796875	
Ethyl Benzene					
Xylenes, total	0.2463809072	0.07038281		1.0779164692	
Methoxychlor				0.0002859766	
TOTAL	5.15	4.97	2.97E-04	22.53	2.17E-04

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Future use questions - will not be residential or be industrial

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- It is assumed that chemical concentrations will remain constant over the duration of an individual's exposure. Movement of groundwater under the Syntex property is likely to produce a progressive dilution of site related contaminants, particularly after the sources have been remediated. By assuming that the measured concentrations of chemicals of concern will remain constant for the next 30 years, it is very likely that exposures will be over-estimated.

- It is conservatively assumed that the adverse effects of exposure to mixtures of chemicals will be additive (US EPA 1989a). This may or may not be true. Furthermore, humans display a diversity of responses to xenobiotic chemicals which cannot be fully incorporated into the risk assessment process.

- Extrapolation of effects observed in laboratory animals to human populations is inherently uncertain. To account for this uncertainty, a factor of 10 (or some multiple) may be used in extrapolating doses from laboratory animals to humans. In general, this is believed to increase the conservatism of the estimate.

- Many of the chemicals present in groundwater associated with the Syntex Agribusiness site are frequently encountered in groundwater and in other media. Site attributable risk can only be determined to the extent that background has been adequately characterized.

There is considerable debate and uncertainty regarding the calculation of Slope Factors for carcinogenic chemicals. In order to be conservative, the U.S. EPA calculates the upper 95% confidence limit of the slope at low doses. Consequently, the actual slope factors may be lower, but are very unlikely to be higher. These calculations also assume that there is no threshold for carcinogenic effects. Again, this may or may not be true for the chemicals under consideration.

The results of any risk assessment must be interpreted in light of the inherent uncertainties. Case specific uncertainties should also be weighed during the interpretation.

CONCLUSIONS

The results of the estimation of noncancer hazards associated with the concentrations of the chemicals of concern indicate that excess hazards (greater than the value of unity accepted by U.S. EPA) may be associated with the ingestion of chromium levels and inhalation (during showering) of chlorobenzene levels found in ground water at the Syntex Facility. (Table 12) Dermal contact (during showering) with the constituent concentrations in ground water does not appear to present a noncarcinogenic health hazard.

The potential cancer risk estimates associated with the concentrations of the chemicals of concern indicate that risks above the level of 1.0E-6 (level considered acceptable by U.S.EPA) may be associated with the ingestion and dermal contact (during showering) with beryllium levels and inhalation (during showering) of benzene and trichloroethylene levels found in ground water at the Syntex Facility.

These findings indicate that adverse human health consequences may potentially exist for receptors utilizing ground water in the vicinity of the Syntex facility.

RECOMMENDATIONS

- A detailed survey of local private wells in the vicinity of the Syntex Facility should be performed to ascertain the actual number of human receptors who may be using ground water downgradient of the site.

- The use designation of local private wells in the vicinity should be determined to demonstrate whether the ground water from the local wells is actually being utilized downstream of the site. The use designation should

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TABLE 12
SUMMARY OF HAZARDS/RISKS ASSOCIATED WITH CHEMICAL CONCENTRATIONS IN GROUND WATER

GROUND WATER EXPOSURE PATHWAY	ADULT			CHILD	
	SUBCHRONIC NONCARC HAZARD	CHRONIC NONCARC HAZARD	CARCINOG RISK	SUBCHRONIC NONCARC HAZARD	CARCINOG RISK
INGESTION	3.57	10.41	6.24E-04	7.80	2.28E-04
SHOWERING/DERMAL CON	0.06	0.19	2.57E-05	0.14	9.51E-06
SHOWERING/INHALATION	5.15	4.97	2.97E-04	22.53	2.17E-04
TOTAL	8.78	15.57	9.47E-04	30.48	4.54E-04

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APPENDIX A

Ground Water Sampling Results
and
Selection of Constituents
of Concern

TABLE A-1 GROUND WATER SAMPLING RESULTS FOR THE SYNTEX FACILITY (MG/L)

	MW1			MW5			MW6			MW7	
COMPOUNDS	SYN 1/30/90	SYN 4/26/90	EPA 7/26/90	SYN 1/30/90	SYN 4/26/90	EPA 7/26/90	SYN 1/30/90	SYN 4/26/90	EPA 7/26/90	SYN 1/30/90	SYN 4/26/90
Al			30			120			500		
As	0.01	0.01		0.01	0.01	0.049	0.015	0.022	0.072	0.016	0.013
Ba	10.5	0.296	1.5	5.42	2.76	3.4	3.26	2.29	6.1	1.9	1.12
Be			0.005			0.014			0.05		
Cd						0.0094			0.061		
Ca	119	48.5	59	97.1	71	75	149	114	190	121	67.8
Cr	30.2	0.731	6.9	0.157	0.119	0.22	0.021	0.005	0.7	0.007	0.032
Co			0.1			0.092			0.3		
Cu			0.065			0.09			0.38		
Fe	301	13.3	80	167	108	150	106	85.4	810	49.2	35.5
Pb	0.322	0.006	0.029	0.173	0.072	290	0.037	0.003	0.73	0.013	0.014
Mg	15.6	2.41	5.3	15.6	11.2	17	11.3	8.23	35	11.1	6.6
Mn	80.8	2.41	13	28.9	11.6	13	12.5	8.78	81	5.87	4.16
Ni			1.9			0.23			0.86		
K			5.4			20			53		
Se	0.005	0.005	0.05	0.005	0.005	0.05	0.005	0.005		0.005	0.005
Ag			0.036			0.028			0.082		
Na	7.7	6.75	8.8	42.5	43.8	0.05	117	104	87	60.2	40.6
Tl			0.1								
V			0.13			0.23			0.77		
Zn			0.25			0.53			2.7		
Methylene Chloride	0.005	0.001	0.005	0.005	0.04	0.005	0.005	0.024	0.005	0.005	0.003
Benzene	0.005	0.005	0.005	0.005	0.017	0.005	0.001	0.005	0.005	0.005	0.005
Trichloroethene	0.005	0.005	0.005	0.005	0.017	0.005	0.005	0.005	0.005	0.013	0.005
Toluene	0.005	0.005	0.005	0.005	0.017	0.005	0.168	0.005	0.005	0.005	0.005
Chlorobenzene	0.005	0.005	0.005	0.064	0.017	0.029	0.169	0.016	0.005	0.02	0.019
Ethyl Benzene	0.005	0.005	0.005	0.005	0.017	0.005	0.029	0.018	0.015	0.005	0.005
Acetone	0.059	0.224	2	0.013	0.836	0.59	0.124	0.151	0.63	0.051	0.203
Carbon Disulfide	0.005	0.005	0.005	0.005	0.017	0.005	0.005	0.005	0.005	0.005	0.002
Xylenes, total	0.005	0.005	0.12	0.005	0.017	0.009	0.142	0.026	0.025	0.005	0.001
1,4-Dichlorobenzene			0.01			0.016			0.11		
1,2,4-Trichlorobenzene			0.01			0.01			0.011		
Bis(2-Ethylhexyl)Phthalate			0.01			0.01			0.01		
Methoxychlor											

TABLE A-1 GROUND WATER SAMPLING RESULTS FOR THE SYNTEX FACILITY (MG/L) (CONTINUED)

	MW15A		MW15B					MW16			
COMPOUNDS	SYN 1/31/90	SYN 4/26/90	EPA 1/30/90	SYN 1/31/90	EPA 2/01/90	SYN 4/26/90	EPA 7/26/90	EPA 1/31/90	SYN 1/31/90	EPA 2/01/90	SYN 4/26/90
Al							0.2	14			
As	0.01	0.01		0.017		0.011		0.01	0.01		0.01
Ba	0.817	2.33	0.047	1.894		2.05	1.1	0.12	0.327		0.196
Be							0.005	0.005			
Cd							0.005	0.0024			
Ca	67.8	85.9	110	132		116	74	65	171		89.5
Cr	0.023	0.182		0.013		0.04	0.01	0.02	0.034		0.009
Co							0.05	0.0081			
Cu							0.025	0.025			
Fe	18.9	149		56.1		80.9	21	13	21.7		7.49
Pb	0.014	0.128		0.022		0.05	0.003	0.015	0.018		0.005
Mg	5.73	11.6	8.8	11.1		10.3	6.5	19	18.5		17.4
Mn	12.9	23.7	0.22	15.1		17.1	4.5	0.7	2.87		11.3
Ni							0.04	0.04			
K							5.5	5			
Se	0.005	0.005		0.005		0.005	0.005	0.005	0.005		0.005
Ag							0.01	0.01			
Na	33.3	27.8	7.4	159		95.6	92	9.6	32.7		48.6
Tl								0.01			
V							0.05	0.028			
Zn			0.068				34	0.21			
Methylene Chloride	0.005	0.28		0.01	0.25	0.667	0.005		0.125	0.005	0.109
Benzene	0.005	0.005		0.01	0.25	0.25	0.005		0.125	0.005	0.034
Trichloroethene	0.005	0.005		0.01	0.25	0.25	0.005		0.125	0.005	0.034
Toluene	0.005	0.005		0.016	0.25	0.25	0.005		0.125	0.005	0.034
Chlorobenzene	0.005	0.005		0.11	0.25	0.25	0.005		0.125	0.005	0.034
Ethyl Benzene	0.005	0.005		0.008	0.25	0.25	0.005		0.125	0.005	0.034
Acetone	0.114	3.93		0.4	9.6	11.79	0.098		4.4	0.19	1.54
Carbon Disulfide	0.005	0.005		0.01	0.25	0.25	0.005		0.125	0.005	0.034
Xylenes, total	0.005	0.005		0.032	0.25	0.25	0.021		0.125	0.005	0.034
1,4-Dichlorobenzene					0.01		0.045			0.01	
1,2,4-Trichlorobenzene					0.01		0.01			0.01	
Bis(2-Ethylhexyl)Phthalate					0.015		0.01			0.009	
Methoxychlor					0.0015					0.00087	

TABLE A-1 GROUND WATER SAMPLING RESULTS FOR THE SYNTEX FACILITY (MG/L) (CONTINUED)

	MW9		MW11		MW15			
COMPOUNDS	SYN 1/30/90	SYN 4/26/90	EPA 1/31/90	EPA 2/01/90	EPA 1/30/90	SYN 1/31/90	EPA 2/01/90	SYN 4/26/90
Al			8.7		2.2			
As	0.03	0.019	0.01		0.014	0.01		0.01
Ba	0.705	1.36	0.18		1.3	0.366		0.05
Be			0.0029					
Cd			0.005					
Ca	74.9	99.2	130		100	231		102
Cr	0.041	0.06	0.031			0.032		0.006
Co			0.024		0.012			
Cu			0.043					
Fe	50.7	113	22		13	16.6		0.236
Pb	0.009	0.057	0.055		0.001	0.029		0.003
Mg	5.55	10.4	34		8.4	12.1		8.72
Mn	5.54	8.53	1.8		11	3.41		0.204
Ni			0.069		0.046			
K			7.3		7.3			
Se	0.005	0.005	0.005			0.005		0.005
Ag			0.01					
Na	79.2	85.5	6.7		110	14.1		5.97
Tl			0.01					
V			0.032					
Zn			0.34		0.085			
Methylene Chloride	0.005	0.003		0.005	0.038	0.005	0.005	0.003
Benzene	0.005	0.005		0.005	0.005	0.005	0.005	0.005
Trichloroethene	0.005	0.005		0.005	0.005	0.005	0.005	0.005
Toluene	0.005	0.005		0.005	0.005	0.005	0.005	0.005
Chlorobenzene	0.049	0.067		0.005	0.002	0.002	0.005	0.005
Ethyl Benzene	0.005	0.005		0.005	0.005	0.005	0.005	0.005
Acetone	0.16	0.01		0.014	0.01	0.038	0.036	0.01
Carbon Disulfide	0.005	0.005		0.005	0.01	0.005	0.005	0.005
Xylenes, total	0.005	0.005		0.005	0.005	0.005	0.005	0.005
1,4-Dichlorobenzene				0.01			0.01	
1,2,4-Trichlorobenzene				0.01			0.01	
Bis(2-Ethylhexyl)Phthalate				0.002			0.008	
Methoxychlor				0.0005			0.0031	

TABLE A-1 GROUNDWATER SAMPLING RESULTS FOR THE SYNTEX FACILITY (MG/L) (CONTINUED)

	MW16B				MW18	
COMPOUNDS	EPA 1/31/90	SYN 1/31/90	EPA 2/01/90	SYN 4/26/90	EPA 1/30/90	EPA 2/01/90
Al					0.46	
As		0.01		0.01	0.01	
Ba	0.068	0.177		0.064	0.25	
Be					0.005	
Cd					0.005	
Ca	43	93.8		53.1	92	
Cr		0.028			0.01	
Co					0.014	
Cu					0.025	
Fe		8.37		0.882	0.57	
Pb	0.0047	0.015			0.003	
Mg	4	4.16		3.75	5	
Mn	0.31	2.56		0.615	2.2	
Ni					0.04	
K	12				5	
Se		0.005		0.005	0.005	
Ag					0.01	
Na	22	19.8		17.2	19	
Tl					0.01	
V					0.05	
Zn	0.094				0.055	
Methylene Chloride		0.005	0.013	0.006		0.005
Benzene		0.005	0.013	0.005		0.005
Trichloroethene		0.005	0.013	0.005		0.005
Toluene		0.005	0.013	0.005		0.005
Chlorobenzene		0.005	0.013	0.005		0.005
Ethyl Benzene		0.005	0.013	0.005		0.005
Acetone		0.148	0.5	0.01		0.01
Carbon Disulfide		0.005	0.013	0.005		0.005
Xylenes, total		0.005	0.013	0.005		0.005
1,4-Dichlorobenzene			0.01			0.01
1,2,4-Trichlorobenzene			0.01			0.01
Bis(2-Ethylhexyl)Phthalate			0.008			0.002
Methoxychlor			0.0013			0.0005

TABLE A-2 BACKGROUND GROUND WATER SAMPLING RESULTS FOR THE SYNTEX FACILITY (MG/L)

	MW14					MW14A		
COMPOUND	EPA 1/31/90	SYN 1/31/90	EPA 2/01/90	SYN 4/27/90	EPA 7/26/90	SYN 1/31/90	SYN 4/27/90	EPA 7/26/90
Al	40				20			4.3
As	0.069	0.078		0.029	0.036	0.01	0.01	
Ba	0.39	0.186		0.173	0.2	0.393	0.139	0.2
Be	0.0024				0.005			0.005
Cd	0.0097				0.005			0.005
Ca	41	64.6		18.9	15	57.9	48.3	49
Cr	0.045	0.017		0.013	0.025	0.033	0.01	0.011
Co	0.036				0.05			0.05
Cu	0.067				0.025			0.025
Fe	36	3.72		9.59	11	17	4.03	3.9
Pb	0.09	0.01		0.024	0.025	0.033	0.01	0.0057
Mg	14	2.72		7.25	7.2	4.94	3.12	5
Mn	1.2	0.175		0.376	0.33	3.56	0.685	0.51
Ni	0.13				0.04			0.04
K	76				23			5
Se	0.005	0.007		0.005		0.005	0.005	0.005
Ag	0.01				0.01			0.01
Na	230	146		87.9	93	5.66	4.46	5.5
Tl	0.01				0.01			0.01
V	0.06				0.05			0.05
Zn	0.25				0.074			0.029
Methylene Chloride		0.05	0.04	0.903	0.005	0.006	0.003	0.005
Benzene		0.05	0.02	0.034	0.005	0.006	0.005	0.005
Trichloroethene		0.05	0.02	0.034	0.005	0.006	0.005	0.005
Toluene		0.05	0.02	0.034	0.005	0.006	0.005	0.005
Chlorobenzene		0.05	0.02	0.034	0.005	0.006	0.005	0.005
Ethyl Benzene		0.05	0.02	0.034	0.005	0.006	0.005	0.005
Acetone		1.34	0.77	0.067	0.5	0.233	0.01	2.1
Carbon Disulfide		0.05	0.2	0.034	0.005	0.006	0.005	0.005
Xylenes, total		0.05	0.02	0.034	0.005	0.006	0.005	0.005
1,4-Dichlorobenzene			0.01		0.01			0.01
1,2,4-Trichlorobenzene			0.01		0.01			0.01
Bis(2-Ethylhexyl)Phthalate			0.004		0.01			0.01
Methoxychlor			0.0005					

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TABLE A-3 GROUND WATER DATA ELIMINATED DURING DATA VALIDATION

PARAMETER	JUSTIFICATION
Volatiles	
Chloromethane	Not detected in background samples or any other sample
Bromomethane	Not detected in background samples or any other sample
Vinyl Chloride	Not detected in background samples or any other sample
Chloroethane	Not detected in background samples or any other sample
1,1-Dichloroethene	Not detected in background samples or any other sample
1,1-Dichloroethane	Not detected in background samples or any other sample
1,2-Dichloroethene	Not detected in background samples or any other sample
Chloroform	Not detected in background samples or any other sample
1,2-Dichloroethane	Not detected in background samples or any other sample
1,1,1-Trichloroethane	Not detected in background samples or any other sample
Carbon Tetrachloride	Not detected in background samples or any other sample
Bromodichloromethane	Not detected in background samples or any other sample
1,2-Dichloropropane	Not detected in background samples or any other sample
Cis-1,3-Dichloropropene	Not detected in background samples or any other sample
Dibromochloromethane	Not detected in background samples or any other sample
1,1,2-Trichloroethane	Not detected in background samples or any other sample
Bromoform	Not detected in background samples or any other sample
Tetrachloroethene	Not detected in background samples or any other sample
1,1,2,2-Tetrachloroethane	Not detected in background samples or any other sample
2-Butone	Not detected in background samples or any other sample
Vinyl Acetate	Not detected in background samples or any other sample
2-Hexanone	Not detected in background samples or any other sample
4-Methyl-2-Pentanone	Not detected in background samples or any other sample
Styrene	Not detected in background samples or any other sample
Trans-1,3-Dichloropropene	Not detected in background samples or any other sample
Trans-1,2-Dichloroethene	Not detected in background samples or any other sample
2-Chloroethylvinylether	Not detected in background samples or any other sample
Semivolatiles	
Phenol	Detected in background samples but not any other sample
Bis(2-Chloroethyl)Ether	Not detected in background samples or any other sample
2-Chlorophenol	Not detected in background samples or any other sample
1,3-Dichlorobenzene	Not detected in background samples or any other sample
Benzyl Alcohol	Not detected in background samples or any other sample
1,2-Dichlorobenzene	Not detected in background samples or any other sample
2-Methylphenol	Not detected in background samples or any other sample
Bis(2-Chloroisopropyl)Ether	Not detected in background samples or any other sample
4-Methylphenol	Not detected in background samples or any other sample
N-Nitroso-Dipropylamine	Not detected in background samples or any other sample
Hexachloroethane	Not detected in background samples or any other sample
Nitrobenzene	Not detected in background samples or any other sample
Isophorone	Not detected in background samples or any other sample
2-Nitrophenol	Not detected in background samples or any other sample
2,4-Dimethylphenol	Not detected in background samples or any other sample
Naphthalene	Detected in background samples but not any other sample
4-Chloroaniline	Not detected in background samples or any other sample
Hexachlorobutadiene	Not detected in background samples or any other sample
4-Chloro-3-Methylphenol	Not detected in background samples or any other sample
2-Methylnaphthalene	Detected in background samples but not any other sample

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TABLE A-3 GROUND WATER DATA ELIMINATED DURING DATA VALIDATION (CONTINUED)

PARAMETER	JUSTIFICATION
Hexachlorocyclopentadiene	Not detected in background samples or any other sample
2,4,6-Trichlorophenol	Not detected in background samples or any other sample
2,4,5-Trichlorophenol	Not detected in background samples or any other sample
2-Chloronaphthalene	Not detected in background samples or any other sample
2-Nitroaniline	Not detected in background samples or any other sample
Dimethylphthalate	Not detected in background samples or any other sample
Acenaphthylene	Not detected in background samples or any other sample
3-Nitroanilene	Not detected in background samples or any other sample
Acenaphthene	Not detected in background samples or any other sample
2,4-Dinitrotoluene	Not detected in background samples or any other sample
2,6-Dinitrotoluene	Not detected in background samples or any other sample
Diethylphthalate	Not detected in background samples or any other sample
4-Chlorophenyl Phenyl Ether	Not detected in background samples or any other sample
Fluorene	Not detected in background samples or any other sample
4-Nitroaniline	Not detected in background samples or any other sample
4,6-Dinitro-2-Methylphenol	Not detected in background samples or any other sample
N-Nitrosodiphenylamine	Not detected in background samples or any other sample
4-Bromophenyl Phenyl Ether	Not detected in background samples or any other sample
Hexachlorobenzene	Not detected in background samples or any other sample
Pentachlorophenol	Not detected in background samples or any other sample
Phenanthrene	Not detected in background samples or any other sample
Anthracene	Not detected in background samples or any other sample
Di-N-ButylPhthalate	Not detected in background samples or any other sample
Fluoranthene	Not detected in background samples or any other sample
Pyrene	Not detected in background samples or any other sample
Butyl Benzyl Phthalate	Not detected in background samples or any other sample
3,3-Dichlorobenzidine	Not detected in background samples or any other sample
Benzo(A)Anthracene	Not detected in background samples or any other sample
Chrysene	Not detected in background samples or any other sample
Di-N-Octyl Phthalate	Not detected in background samples or any other sample
Benzo(B)Fluoranthene	Not detected in background samples or any other sample
Benzo(K)Fluoranthene	Not detected in background samples or any other sample
Indeno(1.2.3-CD)Pyrene	Not detected in background samples or any other sample
Dibenzo(A.H)Anthracene	Not detected in background samples or any other sample
Benzo(G.H<I)Perylene	Not detected in background samples or any other sample
Pesticides	
Alpha-BHC	Not detected in background samples or any other sample
Beta-BHC	Not detected in background samples or any other sample
Delta-BHC	Not detected in background samples or any other sample
Gamma-BHC	Not detected in background samples or any other sample
Aldrin	Not detected in background samples or any other sample
Dieldrin	Not detected in background samples or any other sample
A Endosulfan (I)	Not detected in background samples or any other sample
B Endosulfan (II)	Not detected in background samples or any other sample
Endosulfan Sulfate	Not detected in background samples or any other sample
Endrin	Not detected in background samples or any other sample
Endrin Aldehyde	Not detected in background samples or any other sample
4,4-DDE	Not detected in background samples or any other sample
4,4-DDD	Not detected in background samples or any other sample

TABLE A-3 GROUND WATER DATA ELIMINATED DURING DATA VALIDATION (CONTINUED)

PARAMETER	JUSTIFICATION
4,4'-DDT	Not detected in background samples or any other sample
Toxaphene	Not detected in background samples or any other sample
PCB-1016	Not detected in background samples or any other sample
PCB-1221	Not detected in background samples or any other sample
PCB-1232	Not detected in background samples or any other sample
PCB-1242	Not detected in background samples or any other sample
PCB-1248	Not detected in background samples or any other sample
PCB-1254	Not detected in background samples or any other sample
PCB-1260	Not detected in background samples or any other sample
Chlordane, Technical	Not detected in background samples or any other sample
Heptachlor	Not detected in background samples or any other sample
Heptachlor Epoxide	Not detected in background samples or any other sample
Endrin Ketone	Not detected in background samples or any other sample
Alpha-Chlordane	Not detected in background samples or any other sample
Gamma-Chlordane	Not detected in background samples or any other sample
Total Metals	
Antimony	Not detected in background samples or any other sample
Mercury	Detected in background samples but not any other sample
Cyanide	Not analyzed in any sample
Dissolved Metals	
Aluminum	Not detected in background samples or any other sample
Antimony	Not detected in background samples or any other sample
Beryllium	Not detected in background samples or any other sample
Chromium	Not detected in background samples or any other sample
Copper	Not detected in background samples or any other sample
Nickel	Not detected in background samples or any other sample
Selenium	Not detected in background samples or any other sample
Silver	Not detected in background samples or any other sample
Thallium	Not detected in background samples or any other sample
Vanadium	Not detected in background samples or any other sample
Cyanide	Not analyzed in any sample
Individual Data Points	
MW14 EPA Split Sample dated 7/26/90	
Selenium	Detection limit is higher than the Contract Required Detection Limit
MW 1 EPA Split Sample dated 7/26/90	
Cadmium	Detection limit is higher than the Contract Required Detection Limit
MW5 EPA Split Sample dated 7/26/90	
Thallium	Detection limit is higher than the Contract Required Detection Limit
MW6 EPA Split Sample dated 7/26/90	
Selenium	Detection limit is higher than the Contract Required Detection Limit
Thallium	Detection limit is higher than the Contract Required Detection Limit
MW15B EPA Split Sample dated 7/26/90	
Thallium	Detection limit is higher than the Contract Required Detection Limit
MW16B EPA Split Sample dated 7/26/90	
Selenium	Detection limit is higher than the Contract Required Detection Limit

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TABLE A-3 GROUND WATER DATA ELIMINATED DURING DATA VALIDATION (CONTINUED)

NOTES:

MW5 EPA Split Sample dated 7/26/90 had an unusally high value for total lead. This value falls out of the 95% confidence interval by a significant margin. This data is qualified by the laboratory, however excluding the data from this set is not justified. A resampling event may be necessary to verify this data.

TABLE A-4 COMPARISON OF GROUND WATER RESULTS FOR THE SYNTEX FACILITY AND BACKGROUND SAMPLING LOCATIONS (MG/L)

	SYNTEX					BACKGROUND			
COMPOUND	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	95% C.I.	MINIMUM	MAXIMUM	MEAN	REASON FOR ELIMINATION FROM CONSIDERATION AS CHEMICAL OF CONCERN
Al	0.2	500	75.084	154.50198	384.058405	4.3	40	21.43333	TOXICITY DATA INADEQUATE
As	0.01	0.072	0.0164	0.0139235	0.04430654	0.01	0.078	0.039	BACKGROUND HIGHER
Ba	0.047	10.5	1.6821	2.2068380	6.09583739	0.139	0.393	0.240142	
Be	0.0029	0.05	0.0114	0.0148900	0.04126760	0.0024	0.005	0.004133	
Cd	0.0024	0.061	0.0132	0.0195844	0.05242606	0.005	0.0097	0.006566	
Ca	0.051	231	98.117	44.171130	187.660034	15	64.6	42.1	ESSENTIAL NUTRIENT
Cr	0.005	30.2	1.4681	5.7618625	13.0356259	0.01	0.045	0.022	
Co	0.0081	0.3	0.0722	0.0865940	0.24542137	0.036	0.06	0.045333	ENZYME COFACTOR/NUTRIENT
Cu	0.025	0.38	0.0847	0.1136054	0.31296096	0.025	0.067	0.039	ESSENTIAL NUTRIENT
Fe	0.236	810	84.453	152.49499	389.443720	3.72	36	12.17714	ESSENTIAL NUTRIENT
Pb	0.001	230	7.9942	41.955379	91.9050241	0.0057	0.09	0.028242	
Mg	2.41	35	11.269	7.6052481	26.4798511	2.78	14	6.318571	LEVELS SIMILAR TO BACKGROUND
Mn	0.204	61	12.344	19.309955	50.9643946	0.175	3.56	0.976571	ESSENTIAL NUTRIENT
Ni	0.04	1.9	0.1053	0.3624245	0.83017173	0.04	0.13	0.07	
K	5	53	12.55	14.209028	40.9680576	5	76	34.66666	BACKGROUND HIGHER
Se	0.005	0.05	0.0084	0.0119911	0.03244378	0.005	0.007	0.005333	ESSENTIAL NUTRIENT
Ag	0.01	0.082	0.0063	0.0161292	0.03858116	0.01	0.01	0.01	LEVELS SIMILAR TO BACKGROUND
Na	0.05	159	45.776	41.104605	127.985662	4.46	230	81.78857	BACKGROUND HIGHER
Tl	0.01	0.1	0.005	0.0186125	0.04222518	0.01	0.01	0.01	LEVELS SIMILAR TO BACKGROUND
V	0.028	0.77	0.0432	0.1407451	0.32471617	0.05	0.06	0.053333	LEVELS SIMILAR TO BACKGROUND
Zn	0.055	34	1.9784	7.1198822	16.2182160	0.029	0.25	0.117666	
Methylene Chloride	0.001	0.667	0.0517	0.1289223	0.30962603	0.003	0.903	0.144571	BACKGROUND HIGHER
Benzene	0.001	0.25	0.0256	0.0617270	0.14907919	0.005	0.05	0.017857	
Trichloroethene	0.005	0.25	0.026	0.0616127	0.14922540	0.005	0.05	0.017857	
Toluene	0.005	0.25	0.0310	0.0662629	0.16355717	0.005	0.05	0.017857	
Chlorobenzene	0.002	0.25	0.0416	0.0670292	0.17568352	0.005	0.05	0.017857	
Ethyl Benzene	0.005	0.25	0.0271	0.0614013	0.14995904	0.005	0.05	0.017857	
Acetone	0.01	11.79	1.1843	2.6783542	6.54105222	0.01	2.1	0.717142	COMMON LABORATORY CONTAMINANT
Carbon Disulfide	0.002	0.25	0.0258	0.0616686	0.14914988	0.005	0.2	0.043571	LEVELS SIMILAR TO BACKGROUND
Xylenes, total	0.001	0.25	0.0360	0.0657677	0.16762925	0.005	0.05	0.017857	
1,4-Dichlorobenzene	0.01	0.11	0.0228	0.0293158	0.08144996	0.01	0.01	0.01	
1,2,4-Trichlorobenzene	0.01	0.011	0.0100	0.0002874	0.01066586	0.01	0.01	0.01	LEVELS SIMILAR TO BACKGROUND
Bis(2-Ethylhexyl)phthlate	0.002	0.015	0.008	0.0038847	0.01576940	0.004	0.01	0.008	LEVELS SIMILAR TO BACKGROUND
Methoxychlor	0.0005	0.0031	0.0012	0.0006892	0.00307352	0.0005	0.0005	0.0005	

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APPENDIX B

Toxicity Profiles

(to be provided)

TABLE TOXICITY FACTORS FOR QUANTIFICATION OF CHRONIC AND LIFETIME HAZARDS FOR CONSTITUENTS OF CONCERN (1)

CHEMICAL	CHRONIC NONCARCINOGEN RfDs		CARCINOGEN SLOPE FACTORS		
	ORAL RfD (MG/KG/DAY)	INHALATION RfD (MG/KG/DAY)	CANCER SLOPE FACTOR (ORAL) (MG/KG/DAY)-1	CANCER SLOPE FACTOR (INHALATION) (MG/KG/DAY)-1	CANCER WEIGHT OF EVIDENCE
ALUMINUM	NA	NA	NA	NA	A
BARIUM	7.00E-02	NA	NA	NA	NA
BERYLLIUM	5.00E-03	NA	4.30E+00	8.40E+00	B2
CADMIUM	5.00E-04	NA	NA	6.10E+00	B1
CHROMIUM (2)	5.00E-03	NA	NA	4.10E+01	A
LEAD	NA	NA	NA	NA	B2
NICKEL	2.00E-02	NA	NA	NA	NA
ZINC (3)	2.00E-01	NA	NA	NA	NA
BENZENE	NA	NA	2.90E-02	2.90E-02	A
TRICHLOROETHENE (4)	NA	NA	1.10E-02	1.70E-02	B2
TOLUENE	2.00E-01	5.70E-01 (5)	NA	NA	D
CHLOROBENZENE	2.00E-02	5.00E-03 (6)	NA	NA	D
ETHYL BENZENE	1.00E-01	NA	NA	NA	D
XYLENES, total	2.00E+00	3.00E-01 (6)	NA	NA	D
1,4-DICHLOROBENZENE	NA	7.00E-01 (6)	2.40E-02 (4)	NA	B2
METHOXYCHLOR	5.00E-03	NA	NA	NA	D

(1) Source: IRIS, November 27, 1990 (unless otherwise indicated).

(2) The RfD and Cancer Slope Factor for chromium reflects the most conservative value provided for either chromium (III) chromium (VI): Noncarcinogen Oral Rfd - chromium (VI)
Inhalation Cancer Slope Factor - chromium (VI)

(3) Source for zinc oral RfD values: U.S. EPA, 1989b.

(4) Source for trichloroethene/1,4-dichlorobenzene CSF values: U.S. EPA, 1989b.

(5) Source for toluene RfD values: U.S. EPA, 1989b. Value derived assuming 70 kg body weight and 20 m3/day inhalation rate.

(6) Source for chlorobenzene/xylenes/1-4 dichlorobenzene inhalation RfD values: U.S. EPA, 1989b.

TABLE TOXICITY FACTORS FOR QUANTIFICATION OF CHRONIC AND LIFETIME HAZARDS FOR CONSTITUENTS OF CONCERN (1)

CHEMICAL	CHRONIC NONCARCINOGEN RfDs		CARCINOGEN SLOPE FACTORS		
	ORAL RfD (MG/KG/DAY)	INHALATION RfD (MG/KG/DAY)	CANCER SLOPE FACTOR (ORAL) (MG/KG/DAY)-1	CANCER SLOPE FACTOR (INHALATION) (MG/KG/DAY)-1	CANCER WEIGHT OF EVIDENCE
BARIUM	7.00E-02	NA	NA	NA	NA
BERYLLIUM	5.00E-03	NA	4.30E+00	8.40E+00	B2
CADMIUM	5.00E-04	NA	NA	6.10E+00	B1
CHROMIUM (2)	5.00E-03	NA	NA	4.10E+01	A
LEAD	NA	NA	NA	NA	B2
NICKEL	2.00E-02	NA	NA	NA	NA
ZINC (3)	2.00E-01	NA	NA	NA	NA
BENZENE	NA	NA	2.90E-02	2.90E-02	A
TRICHLOROETHENE (4)	NA	NA	1.10E-02	1.70E-02	B2
TOLUENE	2.00E-01	5.70E-01 (5)	NA	NA	D
CHLOROBENZENE	2.00E-02	5.00E-03 (6)	NA	NA	D
ETHYL BENZENE	1.00E-01	NA	NA	NA	D
XYLENES, total	2.00E+00	3.00E-01 (6)	NA	NA	D
1,4-DICHLOROBENZENE	NA	7.00E-01 (6)	2.40E-02 (4)	NA	B2
METHOXYCHLOR	5.00E-03	NA	NA	NA	D

(1) Source: IRIS, November 27, 1990 (unless otherwise indicated).

(2) The RfD and Cancer Slope Factor for chromium reflects the most conservative value provided for either chromium (III) chromium (VI): Noncarcinogen Oral Rfd - chromium (VI)
Inhalation Cancer Slope Factor - chromium (VI)

(3) Source for zinc oral RfD values: U.S. EPA, 1989b.

(4) Source for trichloroethene/1,4-dichlorobenzene CSF values: U.S. EPA, 1989b.

(5) Source for toluene RfD values: U.S. EPA, 1989b. Value derived assuming 70 kg body weight and 20 m3/day inhalation rate.

(6) Source for chlorobenzene/xylenes/1-4 dichlorobenzene inhalation RfD values: U.S. EPA, 1989b.

TABLE TOXICITY FACTORS FOR QUANTIFICATION OF SUBCHRONIC HAZARDS FOR CONSTITUENTS OF CONCERN (1)

CHEMICAL	SUBCHRONIC RfDs FOR NONCARCINOGENS	
	ORAL RfD (MG/KG/DAY)	INHALATION RfD (MG/KG/DAY)
BARIUM	5.00E-02	1.00E-03
BERYLLIUM	5.00E-03	ND
CADMIUM	ND	ND
CHROMIUM (2)	2.00E-02	ND
LEAD (3)	ND	ND
NICKEL	2.00E-02	ND
ZINC	2.00E-01	ND
BENZENE	ND	ND
TRICHLOROETHENE	ND	ND
TOLUENE	4.00E-01	5.70E-01 (4)
CHLOROBENZENE	2.00E-01	5.00E-03
ETHYL BENZENE	1.00E+00	ND
XYLENES, total	4.00E+00	8.57E-02 (4)
1,4-DICHLOROBENZENE	9.00E-01	4.00E-01
METHOXYCHLOR	1.00E-01	ND

(1) Source: U.S. EPA 1989b.
(2) The RfD for chromium reflects the most conservative value provided for either chromium (III) or chromium (VI): Noncarcinogen Oral Rfd - chromium (VI)
(3) Final draft air quality criteria document (600\8-83-028F) declines to derive an air quality criterion for lead.
(4) Value derived assuming 70 kg body weight and 20 m3/day inhalation rate.

DERMAL HAZARDS AND RISKS ASSOCIATED WITH INDICATOR CHEMICALS

CHEMICAL	ABSORPTION FACTORS USED FOR ORAL TOXICITY VALUES (2)	SUBCHRONIC NONCANCER VALUES		CHRONIC NONCANCER VALUES		CARCINOGEN VALUES	
		SUBCHRONIC ORAL RfD (MG/KG/DAY)	ADJUSTED(2) SUBCHRONIC RfD (MG/KG/DAY)	CHRONIC ORAL RfD (MG/KG/DAY)	ADJUSTED(3) CHRONIC RfD (MG/KG/DAY)	CANCER SLOPE FACTOR (ORAL) (MG/KG/DAY)-1	ADJUSTED(4) SLOPE (MG/KG/DAY)-1
BARIUM	10.00	5.00E-02	5.00E-03	7.00E-02	7.00E-03	NA	NA
BERYLLIUM	10.00	5.00E-03	5.00E-04	5.00E-03	5.00E-04	4.30E+00	4.30E+01
CADMIUM	7.00	NA	NA	5.00E-04	3.50E-05	NA	NA
CHROMIUM (2)	50.00	2.00E-02	1.00E-02	5.00E-03	2.50E-03	NA	NA
LEAD (3)	50.00	NA	NA	NA	NA	NA	NA
NICKEL	10.00	2.00E-02	2.00E-03	2.00E-02	2.00E-03	NA	NA
ZINC	30.00	2.00E-01	6.00E-02	2.00E-01	6.00E-02	NA	NA
BENZENE	90.00	NA	NA	NA	NA	2.90E-02	3.22E-02
TRICHLORDETHENE	100.00	NA	NA	NA	NA	1.10E-02	1.10E-02
TOLUENE	100.00	4.00E-01	4.00E-01	2.00E-01	2.00E-01	NA	NA
CHLOROBENZENE	30.00	2.00E-01	6.00E-02	2.00E-02	6.00E-03	NA	NA
ETHYLBENZENE	80.00	1.00E+00	8.00E-01	1.00E-01	8.00E-02	NA	NA
XYLENES, TOTAL	92.00	4.00E+00	3.68E+00	2.00E+00	1.84E+00	NA	NA
1,4-DICHLOROBENZENE	100.00	9.00E-01	9.00E-01	NA	0.00E+00	2.40E-02	2.40E-02
METHOXYCHLOR	100.00	1.00E-01	1.00E-01	5.00E-03	5.00E-03	NA	NA

(1) Sources for subchronic and chronic RfD/CSF values = U.S. EPA, 1990; U.S. EPA, 1988; ECAO, 1984; U.S. EPA, 1989b.
(2) Oral absorbtion factors are discussed in Appendix D (Source U.S.EPA, 1990).
(3) Adjustment of an administered to an absorbed dose RfD:
(Administered RfD) x (Oral Absorption Factor) = Absorbed Dose RfD
(4) Adjustment of an administered to an absorbed dose slope factor:
(Administered Slope Factor)-1 / (Oral Absorption Factor)
(5) The RfD and Cancer Slope Factor for chromium reflects the most conservative value provided for either chromium (III) chromium (VI): Noncarcinogen Oral Rfd - chromium (VI)
(6) Toxicity factors for PAHs are based on values for benzo(a)pyrene.
(7) Because PAHs such as benzo(a)pyrene are skin carcinogens which act directly at the point of contact, it is inappropriate to use the oral slope factor to evaluate dermal cancer risks for these compounds.